AN ECOLOGICAL SURVEY OF THE WAGON CAVES PROPOSED RESEARCH NATURAL AREA, LOS PADRES NATIONAL FOREST, MONTEREY RANGER DISTRICT, MONTEREY COUNTY, CALIFORNIA

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INTRODUCTION 1
Access 1
PRINCIPAL DISTINGUISHING FEATURES 2
JUSTIFICATIONS FOR ESTABLISHMENT 2
Valley Oak 2
Blue Oak 3
Grassland Values 4
Riparian Vegetation 5
Rare Flora 5
PHYSICAL AND CLIMATIC CONDITIONS 5
VEGETATION AND FLORA 6
Vegetation Types 7
Valley Oak Woodland 7
Blue Oak Woodland 13
Grassland 16
Sage Scrub 18
Chamise Chaparral 19
Rock Outcrop 20
Riparian Vegetation 20
FAUNA 22
GEOLOGY 23
SOILS 24
CULTURAL VALUES 25
IMPACTS 26
Recreation 26
Grazing 27
MANAGEMENT CONCERNS 28
RECOMMENDATIONS 29
Boundary Options 29
REFERENCES 30
APPENDICES 34
Vascular Plant List 34
Vertebrates Noted 41
PHOTOS 44
MAPS 46

INTRODUCTION

The Wagon Caves candidate Research Natural Area (WCRNA) is on the Monterey Ranger District of the Los Padres National Forest. The area was selected and nominated by the Los Padres National Forest as a candidate RNA in 1986 to preserve an example of the valley oak (*Quercus lobata*) target element for the Pacific Southwest Region RNA system.

The WCRNA as defined in this report covers 806 acres (326 ha). The boundaries differ from that originally proposed by the Forest (map 5). The approximate center of the area is at latitude 36° 05' N, longitude 121° 24' E. It lies within the western portion of the Las Milpitas Land Grant and has not been divided into sections. It occurs within T21S, R5E Mount Diablo Base and Meridian. Elevations range from ca. 1370 ft. (418 m) at the junction of the North Fork of the San Antonio River and Rattlesnake Creek to 2465 ft. (751 m) atop the ridge in the northwestern corner (see maps 1 and 2).

Access (reference maps 1 and 2):

The WCRNA is accessible from the south through the Hunter Liggett Military Reservation via the following route. From the Monterey Ranger District headquarters at King City, drive southeast on county road G14 approximately 24 miles (39 km) to Jolon. Turn northwest on the San Antonio Mission Road (county route 4050) through the reservation checkpoint and continue ca. 19 miles (31 km) to the edge of the military reserve (marked by fences and cattle guards). The WCRNA is immediately adjacent to the Hunter-Liggett Reserve and lies approximately 5 miles (8 km) south of the Santa Lucia Memorial Park Campground. Total mileage to the center of the RNA from King City is ca. 45 (72 km) and driving time is about 1 hour.

Once within the boundaries of the RNA there are several unimproved roads branching off county route 4050, which bisects the area running northwest-southeast. These unmaintained dirt roads traverse the main savanna area on the southern side of the RNA. A loop road also leads to Wagon Caves and the open savanna area in the southeast corner. Another road along the eastern edge of the area leads northeast up to Rattlesnake Creek. From this point a fuel break runs up the chaparral-covered ridge forming the northern boundary of the area.

PRINCIPAL DISTINGUISHING FEATURES

The distinctive savannas of valley oak are a dying symbol of California. The stands of this species at Wagon Caves are the only ones chosen within the PSW RNA system to represent the valley oak target element. The valley oak vegetation occurs as open old growth savanna with trees attaining girths of from 5-7 ft. (1.5-2.1 m) dbh in the eastern part of the area, and by younger cohorts of trees in the northwestern part of the area. The densities of the stands vary from open savanna with 13 trees/ha to forests of ca. 200/ha. Although small in area, the Wagon Caves RNA contains a diversity of vegetation types. These range from dense chamise (*Adenostoma fasciculatum*) chaparral, closed canopy coast live oak (*Quercus agrifolia*) and white alder-sycamore (*Alnus rhombifolia-Platanus racemosa*) riparian forests; to open valley oak and blue oak (*Quercus douglasii*) savannas. Well developed areas of annual introduced and perennial native grassland, and cliff and crevice vegetation on the Wagon Caves outcrops also occur in the RNA.

The WCRNA is underlain by rocks of both sedimentary and granitic origin, the latter deposited primarily as alluvium in a broad terrace up to 1.2 km wide above the banks of the North Fork of the San Antonio River. The bold outcrops of sandstone in the southwest corner of the area are known as Wagon Caves.

Several types of streams are in the area, including the low gradient San Antonio River (with segments of perennial flow), and the steeper gradient intermittent Santa Lucia Creek (also known as Sycamore Creek).

JUSTIFICATIONS FOR ESTABLISHMENT

Valley Oak:
This candidate RNA is the only site chosen to represent the valley oak target element in the PSW RNA system. The valley oak is a well known tree of the lowlands and foothills of cismontane California. It has suffered extensive reductions in population as a result of land clearing and intensive management for croplands throughout most of its range (Griffin 1973a, Johnson 1985, Kirn 1982). It has also become threatened through a reduction in recruitment of saplings and seedlings. The latter circumstance is a result of complex factors including predation by introduced livestock,

and increases in native acorn and seedling predators such as pocket gophers, deer, and ground squirrels (Griffin 1971, 1976).

Valley oak vegetation occurs in two principal forms throughout the State (Holland 1986). In the bottomlands of the Central Valley it occurs in riparian forests, which may be relatively dense and closed-canopied (Conard et al. 1977, Holland 1986). Its most widespread representation is as an open park-like woodland, often considered part of the California foothill woodland vegetation (Griffin 1977). This phase of the valley oak's distribution encompasses relatively flat alluvial deposits as well as rolling uplands and occurs (or once occurred) throughout much of the Central Valley and its surrounding foothills. Less extensive stands exist in the lowlands and foothills of the Coast Ranges (Griffin 1977).

Some of the best remaining examples of the open park-like stands are in the Santa Lucia Range of Monterey County (Griffin 1977). The vegetation and other ecological relationships within these woodlands has been studied by White (1966), Griffin (1971, 1973b, 1975, 1976, 1980a, 1980b), Fieblekorn (1972), and Koenig 1980). The valley oak vegetation in the Santa Lucia Mountains ranges from valley bottom to montane summit stands (up to 5000 ft., 1524 m).

Valley oak at the WCRNA occurs in the alluvial terrace form, typical of the stands studied by Griffin (1976) in the Nacimiento and San Antonio River valleys. These woodlands have an understory dominated by non-native annual grasses, but also include numerous native herbs and native annual and perennial grasses. Stand structure ranges from very open with large several hundred year-old monarchs on relatively flat Santa Ynez soils to denser stands of trees under 100 years along the edges of rills and swales on Arroyo Seco and Lockwood soils. Recent reproduction is generally poor throughout. Numerous seedlings occur; however, saplings are extremely rare.

Blue Oak:
In addition to the targeted stands of valley oak, a smaller portion of the WCRNA is dominated by blue oak woodland. Both blue and valley oaks share similar climatic regimes throughout California (Griffin 1977, Barbour 1988), but blue oak typically occurs on shallower, poorer soils with deeper water tables. It is therefore more widespread in upland situations than the valley oak. Both species also share problems relating to recent reproduction

(Johnson 1985, Borchert et al. 1989).

At WCRNA the blue oak woodland is restricted to recently eroded San Andreas soils of the lower terrace deposits, particularly adjacent to the northern base of the Wagon Caves rock outcrops. Here, recent gullying has created a network of shallow drainages cutting 15-30 ft. (4.5-9 m) into the broad alluvial terraces. The blue oaks dominate along the edges and slopes of these drainageways. The blue oaks of WCRNA may attain large sizes, comparable to valley oaks in some cases, up to 3 ft. (1 m) dbh and 70 ft. (21 m) in height.

Blue oak woodland is not currently represented within the PSW RNA system in the South Coast Ranges Province (Keeler-Wolf 1989). Although the small size of the WCRNA blue oak stands may limit research possibilities, their co-occurrence with more extensive valley oak vegetation affords comparison and potential long term studies of the community dynamics of these two related deciduous oak woodlands.

Grassland Values:
Compared to other California grasslands described by Heady (1977), Barbour and Major (1988), White (1967), and Sims (1988) the native grass and herb component at Wagon Caves is high. Virtually all native perennial species which could have hypothetically dominated the pristine pre-European grassland at this site are still present. These include; *Stipa cernua, Muhlenbergia rigens, Elymus glaucus, Koeleria macrantha, Poa scabrella, P. howellii, Elymus glaucus, Melica californica,* and *M. imperfecta*.

In addition to the native grass species is a rich and diverse native herb component including patches of high density "wildflower fields". Although introduced Mediterranean annuals presently dominate much of the area, a recently burned (1985) grassland within the blue oak woodland has over 50% of its vegetation cover composed of native species. This suggests that with the proper management (e.g., frequent fire and reduced grazing pressure), much of the grassland in the area could revert to high diversity native representation.

Riparian Vegetation:
Several types of riparian vegetation occur within the RNA. Along the upper banks of both Rattlesnake and Santa Lucia Creeks is a band of coast live oak riparian woodland. In the bouldery alluvium of Santa Lucia Creek is a woodland with scattered white alder and California sycamore. At the northeastern corner of the RNA a dense white alder riparian stand occupies the small stretch of permanent water along Santa Lucia Creek. Along the North Fork of the San Antonio River below the Wagon Caves outcrops is a well developed riparian community dominated by white alder, willows (*Salix lasiandra, S. melanopsis*), mule fat (*Baccharis viminea*) and sycamore.

These various riparian stands contain a diversity of associated wetland plants and are homes to a variety of invertebrates and vertebrate animals.

Rare Flora:
Quercus lobata (CNPS list 4), is the only species known from the area currently listed by the California Native Plant Society (Smith and Berg 1988).

PHYSICAL AND CLIMATIC CONDITIONS

The WCRNA lies on the eastern side of the Santa Lucia Mountains. It is in the rain shadow east of Cone Peak in the valley of the upper North Fork of the San Antonio River.

The area is dominated by a gently sloping alluvial terrace which has accumulated as a result of alluvial outwash from the three major drainages in the area. This terrace slopes down to the southwest toward the banks of the North Fork of the San Antonio River. It is over 1 km wide in some areas and runs the length of the RNA. The terrace is dissected by several small arroyos and minor rills. The intermittent streams of Rattlesnake Creek (on the southeast) and Santa Lucia Creek (on the northwest) incise the terrace as does a dendritic pattern of short drainageways converging on the northwest side of the Wagon Caves sandstone outcrops. To the northeast of the terrace is a steeply sloping ridge of shale and sandstone, the crest of which forms the northeastern boundary of the area.

According to Rantz (1972) the area receives from ca. 30 to over 40 inches (762-1016+ mm) of precipitation as a yearly average. Rainfall patterns are complex in the vicinity of the WCRNA. Only five miles (8 km) to the west of the area on the eastern face of Cone Peak, Talley (1974) reports rainfall annual averages of 90 inches (2286 mm). While a few miles to the southeast, within the Hunter Liggett Reservation, rainfall averages less than 20 inches (508 mm) annually (Rantz 1972). Rainfall comes in the typical Californian pattern with over 80% falling between November and April. Very little precipitation falls in the summer. The average annual water deficit is between 8 and 16 inches (200-400 mm) and there is generally very little water surplus (averaging < 8 inches or 200 mm/year) (Donley et al. 1979).

Temperatures are mild in the RNA. The following information has been gleaned from Donley et al. (1979). With low elevations and proximity to the coast, the average annual range of (high to low) temperatures is likely to be relatively small, about 48-53° F (9-12° C). The average length of frost free period is 300-330 days per year. Light frosts are fairly common (30-60 days with minima below 0° C) in the winter months with the coldest temperatures generally occurring in January, which averages between 48 and 53° F (9-12° C). The area has little direct marine influence; coastal fog is virtually unknown from the area. Summer temperatures may reach 110° F (43° C) in July and August, which are the warmest months. There are between 30-60 days each year when temperatures are higher than 90° F (32° C). The average temperature of the warmest month is between 64-70° F (18-21° C). The average annual temperature is probably between 58 and 60° F (14-16° C).

During the visit for this ecological survey in late May 1988, high temperatures were 86-94° F (30-34° C).

VEGETATION AND FLORA

The flora of the WCRNA is relatively rich for the small area. A total of 227 taxa have been identified (Appendix 1). The herbaceous vegetation of the oak woodlands, rock outcrops, and the riparian areas is particularly diverse. Despite the diversity, there are no Forest, State or Federally listed rare or endangered species and few plants of limited distribution. The only CNPS species known from the area is *Quercus lobata* (list 4, Smith and Berg

Table 1: Acreage of vegetation types in Wagon Caves candidate RNA.

Vegetation Type: (with Holland, Kuchler, and SAF code equivalents)	acres	hectares	% of total
valley oak woodland (H 71130)	319	129.1	39.6
grassland (H 42110, H 42200, H 42300, K 41))	115	46.5	14.3
Blue oak woodland (H 71140, SAF 250, K 26)	99	40.0	12.3
chamise chaparral (H 37200, K 29)	99	40.0	12.3
riparian (H 61210, H 61220)	85	34.4	10.5
rock outcrop (no equivalents)	56	22.7	6.9
sage scrub (H 32600, K 30)	33	13.4	4.1
totals	806	326.1	100.0

their roots, and this disturbance fosters the presence of additional non-native herbs such as *Marrubium vulgare* and *Urtica urens* (photo 6).

Dense, species-poor, non-native vegetation beneath oaks in contrast to more open and diverse adjacent grassland has been observed elsewhere in California under blue oaks (Holland 1974, McClaran and Bartolome 1989), coast live oaks (Parker and Muller 1982) and California black oaks, *Quercus kelloggii* (Keeler-Wolf 1986a), and is apparently connected to higher nutrient levels, possible alleopathic effects, and less droughty conditions beneath oak canopies.

Vegetation sampling was conducted in both phases of valley oak woodland. At the eastern side of the area 16 points were sampled using the point-center quarter technique (Cox 1972). Associated with these points sixteen 50 m^2 plots were sampled to provide estimates of grass and herb cover. In the west-central portion ten points were sampled (also point- center quarter) within a stand of young valley oaks in conjunction with ten 50 m^2 plots for herbaceous vegetation. Tables 2 and 3 summarize the results for the understory.

The tree stratum is completely dominated by valley oak with no other species present in the sample. The eastern sampling area has a mean density of 5 trees/ac. (13 trees/ha) and an average basal area cover of 57 $ft.^2$/ac. (13.14 m^2/ha). The average tree is 44" (1.13 m) dbh (range 19-78" or 0.48-1.98 m). This is a very open woodland which is dominated by large old trees, containing few trees under 2.5 ft. (76 cm) dbh. The ages of two of the larger trees in the sample are estimated by ring counts of outer cambium layers to be around 550 years old. Few of the trees in this stand (ca. 10%) are likely to be under 200 years.

In contrast, the stand in the west-central portion of the area is composed of much younger and denser valley oak. Two 13" (33 cm) dbh trees had ages of 83 and 88 years. A 20" (51 cm) dbh stem was 93 years and one of the larger trees in the stand, a 34" (86 cm) dbh specimen, was 175 years. Results from the sampling in this area indicate an average density of 79 trees/ac. (195 trees/ha) with a basal area cover averaging 139 $ft.^2$/ac (32.0 m^2/ha). The average tree is 18" (45 cm) dbh (range 10.5-43" or 27-109 cm). Thus,

Table 2: Herbaceous vegetation associated with old growth valley oak woodland on sixteen 50 m^2 plots, Wagon Caves CRNA.

Species	Frequency	x % Cover
Bromus diandrus	0.75	38.75
Bromus mollis	0.81	13.75
Erodium cicutarium	0.69	9.56
Avena fatua	0.56	6.56
Lotus purshianus	0.44	6.31
Lupinus nanus	0.31	3.25
Stipa cernua	0.44	2.13
Vulpia dertonensis	0.13	1.56
Vulpia myuros	0.13	1.56
Torilis japonica	0.31	1.38
Cryptantha sp.	0.31	1.31
Linanthus liniflorus	0.06	1.25
Navarretia atractyloides	0.06	0.94
Lupinus densiflorus	0.13	0.75
Sidalcea sp.	0.06	0.75
Geranium molle	0.13	0.63
Clarkia purpurea	0.25	0.44
Amsinckia intermedia	0.31	0.31
Sanicula crassicaulis	0.06	0.31
Sitanion jubatum	0.06	0.31
Carex sp.	0.06	0.25
Avena barbata	0.13	0.25
Melica californica	0.06	0.13
Brassica nigra	0.25	0.06
Delphinium parryi	0.06	0.06
Bromus carinatus	0.19	-
Thysanocarpus curvipes	0.13	-
Verbena leucostachys	0.13	-
Caucalis microcarpa	0.06	-
Elymus glaucus	0.06	-
Hordeum leporinum	0.06	-
Juncus balticus	0.06	-
Linanthus ciliatus	0.06	-
Lupinus bicolor	0.06	-
Medicago hispida	0.06	-
Total Cover		92.56

Table 3: Herbaceous species associated with ten 50 m^2 plots in young valley oak woodland, Wagon Caves CRNA.

Species	Frequency	x % Cover
Bromus diandrus	0.80	20.5
Bromus mollis	0.70	14.0
Bromus arenarius	0.40	10.0
Daucus pusillus	0.70	7.5
Avena barbata	0.70	5.4
Torilis japonica	0.30	3.5
Geranium molle	0.60	2.5
Toxicodendron diversilobum	0.40	2.1
Madia gracilis	0.20	1.5
Elymus glaucus	0.30	1.1
Lolium multiflorum	0.30	0.8
Erodium cicutarium	0.10	0.5
Urtica urens	0.10	0.5
Melica californica	0.20	0.4
Vulpia myuros	0.10	0.3
Galium andersonii	0.20	0.2
Bromus carinatus	0.20	0.1
Sanicula crassicaulis	0.50	-
Lotus purshianus	0.30	-
Delphinium parryi	0.20	-
Cirsium proteanum	0.20	-
Sidalcea sp.	0.20	-
Anagallis arvensis	0.10	-
Brassica nigra	0.10	-
Lotus sp.	0.10	-
Ranunculus californicus	0.10	-
Verbena leucostachys	0.10	-
Total Cover		70.9

although the average tree is substantially smaller (ca. 2.4 X) than the average individual in the open stand, the greater densities (almost 15 X the open stand) make up for the stature and translate to a basal area cover ca. 2.5 X higher than in the open stand.

The heights of the large trees in the open stand range from ca. 80-100 ft. (24-30 m), while trees in the denser stand are 50-70 ft. (15-21 m) tall. Some of the open stand trees are senescent as indicated by heavy mistletoe loads and large hollowed-out trunks (see photo 6). However, the majority appear healthy.

Recent reproduction in both stands is limited to seedlings. It is apparent that neither area has had any successful survivorship into sapling size classes in the past 60-90 years. However, seedling densities and frequencies are high, as follows: open woodland 612/ac. (1513/ha), 50% of plots; dense woodland 1352/ac. (3340/ha), 90% of plots. These high densities and frequencies indicate that substantial seed was available at least during the year immediately preceding the sampling. It is likely that intense predation upon seedlings occurs throughout the area. Deleterious factors analysed by Borchert et al. (1989) such as predation by gophers, cattle, and mice, as well as acorn dessication and soil compaction probably all combine to cause poor reproduction. It is likely that drought during the first summer is the single most important factor causing the demise of the seedlings that do get established (Borchert et al. 1989).

The burst of reproduction responsible for the cohort of trees aged between 83 and 100 years is probably similar in character to those noted in other stands of blue oak and valley oak (White 1966, Vankat and Major 1978, Griffin 1977, Barbour 1988). There apparently were favorable conditions for oak regeneration throughout much of California in the late 1800's.

The understory of both dense and open stands are similar (see tables 2 and 3). Both are dominated by annual introduced grasses and both have relatively high cover. However, the open stand has about a 20% higher average cover with almost double the cover of *Bromus diandrus* , the dominant species. Another difference between the two stands is the occasional presence of *Toxicodendron diversilobum* in the young, dense stand. This species is the only woody understory member of the woodland and occurs as a vine clambering up oak trunks. *B. diandrus* and to a lesser

extent *B. arenarius* are limited to semi-shaded areas beneath the canopy of the oaks, and are rare elsewhere in the woodland. There is a clear trend for such native species as *Stipa cernua, Lotus purshianus, Lupinus nanus,* and *Vulpia grayi* to occur in sunnier areas away from the oak canopy. *Avena* and *Vulpia myuros* also tend to be more common in open areas.

Valley oak woodland is not completely limited to deep alluvial soils. In a small area in the north-central part of the RNA it occurs with blue oak and coast live oak on slopes up to 20° on San Andreas fine sandy loam (photo 7). The trees in this area are generally small and relatively young, but occasional larger monarchs exist. In this area the valley oaks are generally restricted to relatively mesic microsites such as the edges of drainageways and more northerly exposures with blue oaks on xeric west and south slopes and coast live oak on the steeper, rocky slopes.

Blue Oak Woodland (71140): This association is limited to the San Andreas fine sandy loam soils associated with the dendritic drainageways of the south-central part of the RNA (photo 8). It occurs on generally steeper and shallower soils than adjacent valley oak woodland. At the edge of the Wagon Caves escarpment, occasional Digger pine (*Pinus sabiniana*) and scrubby interior live oak (*Quercus wislizenii*) may be found within the woodland. As mentioned in the previous vegetation type, blue oak co-occurs with valley oak in a small area of steeply sloping San Andreas soil in the north-central part of the area. However, over the majority of its extent in the RNA this woodland is completely dominated by blue oak.

Compared with the valley oak woodland, the blue oak type is dominated by smaller trees of relatively uniform density and size (photo 9). Although the understory is similarly herb and grass dominated, the cover and diversity of native species is markedly higher than in the local valley oak woodlands.

Ten points were sampled in the blue oak woodland adjacent to the western side of Wagon Caves rocks. Associated with these points were ten 50 m^2 plots sampling understory vegetation (Table 4). A comparison between table 4 and tables 2 and 3 indicates a 20-40% lower overall average herbaceous cover (55%) for blue oak woodland and a significantly higher dominance of native species. A full 59% of the cover in blue oak woodland is composed of native species, whereas only 19-20% of the valley oak understory vegetation cover is native. One of the reasons for this discrepancy appears

Table 4: Herbaceous species on ten 50 m^2 plots in blue oak woodland, Wagon Caves cRNA.

Species	Frequency	x % Cover
Avena fatua	0.8	9.5
Stipa cernua	0.8	7.7
Lagophylla ramosissima	0.4	7.7
Daucus pusillus	0.5	6.9
Vulpia myuros	0.5	6.5
Erodium cicutarium	0.3	3.0
Madia gracilis	0.4	2.4
Lotus subpinnatus	0.3	2.0
Centaurea melitensis	0.5	1.7
Bromus mollis	0.3	1.5
Galium andersonii	0.2	1.5
Lupinus densiflorus	0.1	1.0
Trifolium albopurpureum	0.1	1.0
Koeleria macrantha	0.2	0.7
Medicago hispida	0.3	0.5
Melica californica	0.3	0.4
Orthocarpus densiflorus	0.4	0.3
Lonicera interrupta	0.1	0.3
Sidalcea sp.	0.1	0.3
Clarkia purpurea	0.6	-
Delphinium parryi	0.3	-
Linanthus ciliatus	0.3	-
Cirsium proteanum	0.2	-
Poa scabrella	0.2	-
Anagallis arvensis	0.1	-
Bromus diandrus	0.1	-
Calochortus supurbus	0.1	-
Clarkia rhomboidea	0.1	-
Eriophyllum confertiflorum	0.1	-
Hordeum californicum	0.1	-
Juncus mexicanus	0.1	-
Lupinus nanus	0.1	-
Madia sp.	0.1	-
Madia exigua	0.1	-
Navarretia atractyloides	0.1	-
Plantago hookeriana	0.1	-
Rigiopappus leptocladus	0.1	-
Sanicula bipinnitifida	0.1	-
Torilis japonica	0.1	-
Total Cover		54.9

to be associated with the recent fire history of the two woodlands.

Virtually the entire blue oak woodland southwest of the main road in the RNA sustained a ground fire in the 1985 Rat Fire (July 23, 1985 aerial photos). Conversely, the majority of the valley oak woodland was not affected by this fire.

A recent study of fire regimes in annual grassland in the Sierra foothills (Parsons and Stohlgren 1989) suggests that spring and fall fires result in a decrease in the biomass of introduced annual species such as *Bromus diandrus* and *Avena fatua*, which often account for the majority of the pre-burn biomass. According to Parsons and Stohlgren, following a burn, native forbs such as *Lotus subpinnatus* and *Orthocarpus attenuatus* show a sharp increase in biomass, which maintain high levels for several years. The authors conclude that, in general, frequent fires increase diversity of annual grassland and reduce the dominance by a few non-native grass species. The lack of increase in native grasses following burns in their study may have to do with the rarity of native grasses in their area.

This trend appears to be repeated in the Wagon Caves blue oak woodland understory. Native species such as *Lagophylla ramosissima* and *Stipa cernua* occur in much higher cover than in portions of the RNA unburned in 1985 and the cover of non-native grasses is much lower on burned blue oak woodland than elsewhere in oak woodlands. In addition, diversity on ten plots in blue oak woodland is 69% higher than on ten plots in young valley oak woodland. Additional comments on the management of grassy understories and grassland within the RNA are given in the recommendations section.

The point-center quarter data indicates that blue oak averages 66 trees/ac (162/ha) with a mean basal area cover of 36.15 $ft.^2$/ac. (14.67 m^2/ha). The average dbh of trees is 13.39" (334 cm). The blue oak woodland at Indian Creek cRNA (Keeler-Wolf 1986b) averages 52 trees/ac. (128 trees/ha) with a basal area of 36.15 $ft.^2$/ac (8.30 m^2/ha). Other density values for blue oak woodland cited by Griffin (1977) range from 51-79 trees/ac. (126-195 trees/ha). White's (1966) basal area cover for blue oak in the upper Carmel Valley ranges from 64.02 $ft.^2$/ac. (14.7 m^2/ha) on ridgetop stands to steep north slope stands with 107.14 $ft.^2$/ac. (24.6 m^2/ha).

Compared to Indian Creek (Keeler-Wolf 1986b) the size class distribution of blue oak at Wagon Caves is less equitable (Table 5) with only three of the size classes having 15% or more frequency of individuals as opposed to four at 15% or more at Indian Creek. Unlike Indian Creek, the smallest size class (0.5-2" dbh) at Wagon Caves is not represented and frequency distribution is skewed more toward the large size classes at Wagon Caves. In fact, some very large blue oaks occur at Wagon Caves. The largest are over 3 ft. (1 m) dbh and are at least 70 ft. (21 m) tall (photo 10). However, there is little evidence of recent reproduction. Unlike the local valley oak stands, even seedlings are poorly represented, with only 16 seedlings/ac. (40/ha).

Table 5: Frequency (%) of size classes in the blue oak woodland at Indian Creek and Wagon Caves.

Size Class (in inches dbh)	Wagon Caves (%)	Indian Creek %
0.5-2.0	0	2.8
2.5-5	5.0	19.4
5.5-8	15.0	20.8
8.5-12.0	22.5	33.3
12.5-16	37.5	16.6
16.5-20	5.0	2.8
20.5-25	12.5	4.2
25.5-30	2.5	0

It remains a question to ponder why blue oak reproduction is at even a lower level than valley oak reproduction in this area. Perhaps lasting effects of the Rat Fire (e.g., nutrient level differences) has had some effect on seedling establishment.

Grassland (42110, 42200, 42300): This association is variable in the study area and contains elements from Holland's valley needlegrass grassland, non-native grassland, and wildflower field communities. It is typically associated with the valley oak and blue oak woodlands, but also occurs adjacent to sage scrub on the steeper lower slopes of the northeastern ridge. The majority of understory species listed for the valley oak and blue oak woodlands also occurs in the local grasslands. In fact, depending upon

what scale they are viewed it is difficult, if not unwise, to make distinctions between grassland and oak woodland-savanna understory. In this report grassland is considered any herb and grass dominated association not associated with direct canopy effects of oaks or other woody species, and not on rocky substrate.

The grassland in the RNA is a relatively open type with rarely more than about 60% ground cover. It is dominated by different species depending on characteristics of exposure and soil development.

The modal grassland adjacent to the very open valley oak savannas of the southeastern part of the study area is dominated by *Avena fatua*. This species is estimated to compose about 10-35% cover. *Stipa cernua* is the predominant native perennial although it usually does not occur in extensive patches (photo 11). *Bromus mollis* is common (ca. 5-10% cover) and evenly dispersed and the introduced *Bromus rubens, Vulpia myuros* and *V. dertonensis* are scattered in small patches. Native herbs are variable in abundance. The most ubiquitous species include *Lotus purshianus, Agoseris retrorsa, Brodiaea jolonensis, Clarkia rhomboidea, C. purpurea, Daucus pusillus,* and *Lupinus nanus*. A number of non-native annual herbs occur including *Erodium cicutarium* (a dominant in late winter-early spring), *Medicago hispida*, *Hypochoeris glabra*, *Centaurea melitensis*, and *Brassica nigra*.

In addition to *Stipa cernua,* several other native grasses are scattered throughout the grassland, suggesting that with alternative management, the native component could increase. These species include; *Muhlenbergia rigens, Poa scabrella, P. howellii, Elymus glaucus, Bromus carinatus, Koeleria macrantha, Melica californica, M. imperfecta* var. *flexuosa, Scribneria bolanderi, Sitanion jubatum* and *Vulpia grayi.* Compared to White's (1967) study of relictual native grassland at Hastings Reservation in the upper Carmel River Valley where only one perennial species of grass (*Stipa pulchra*) occurs, Wagon Caves grassland and savanna has nine perennial species (photo 12).

Dominance varies between grasses and herbs from year to year and from place to place. From my short visit it was apparent that at least two subtypes of grassland were present in addition to the modal type described above. One of the most obvious is the native wildflower dominated type.

This is an ephemeral vegetation which exhibits spectacular mass displays of annuals in the spring (photos 13 and 14). Among the important species in this subtype are *Linanthus linifolius, L. ciliatus, Clarkia purpurea, C. rhomboidea, Lotus subpinnatus, Lasthenia leptalea, Madia gracilis,* and *Chorizanthe staticoides*.

Another type occurs often intergrading with sage scrub on shallow rocky soil derived from sandstone. This type is steeply sloping and is dominated by *Avena fatua* with a number of herbs such as *Cirsium proteanum, Convolvulus malacophyllus, Lupinus nanus, Centaurea melitensis, Orthocarpus densiflorus, Plantago hookeriana, Chorizanthe membrenacea, Corethrogyne filaginifolia, Eriophyllum confertiflorum* and *Calochortus supurbus.*

Sage Scrub (32600): This association forms an irregular zone between the grassland and chamise chaparral on the steep (30-75%) slopes of the northeastern boundary ridge. Soils are Reliz association and are shallow and rocky, derived from sandstone and shale.

The characteristic species in this association are *Artemisia californica, Yucca whipplei* ssp. *percursa, Lotus scoparius, Avena fatua, Eriogonum fasciculatum, Galium nuttallii, G. californicum, Lupinus albifrons, Zauschneria californica* ssp. *mexicana*, *Stephanomeria virgata*, and *Monardella villosa*. The introduced *Avena* and the native shrub *A. californica* tend to co-dominate as grassy areas interspersed with patches of shrubs. Rock outcrops are often associated with this vegetation (photo 16) and exposures are typically more xeric than in adjacent chaparral. Associated with the outcrops are other species such as *Mimulus bifidus* ssp. *fasciculatus, Keckiella breviflora, Heteromeles arbutifolia, Phacelia ramosissima, Dudleya cymosa, Selaginella bigelovii, Pholistoma auritum,* and *Pellaea andromedaefolia*. The standard southern California pattern of sage scrub occupying the lower south-facing slopes and chaparral occupying the upper more mesic slopes (e.g. Mooney 1977, Barbour and Major 1988) is repeated here.

Rare shrubs of *Baccharis pilularis* var. *consanguinea* in this association suggest an affinity to Santa Lucian sage scrub (Holland 1986), the more coastal scrub typical of seaward slopes in the Santa Lucias. Black sage (*Salvia mellifera*) is often a co-dominant with *Artemisia californica* in Diablan sage scrub, but is locally absent, the nearest colonies a mile or so

away near The Indians (noted on Map 2).

Chamise Chaparral (37200): This widespread and well known chaparral occurs on the upper slopes of the northeastern boundary ridge. It is dominated by *Adenostoma fasciculatum*, which commonly composes 70-100% of the shrub cover. The entire stand was burned in the spring of 1975 in The Indians Fire. Some charred snags and sticks remain on resprouted shrubs and indicate that the pre fire height of chamise was up to 10 ft. (3 m). Present average height is about 4.5 to 6 ft. (1.4-1.8 m). However, shrubs of *Quercus dumosa* may be up to 20 ft. (6 m).

In addition to the dominant chamise, several other chaparral shrubs occur in the area. They include *Quercus dumosa, Arctostaphylos glandulosa, Dendromecon rigida, Ceanothus papillosus, Pickeringia montana,* and *Heteromeles arbutifolia.* These species are more common, forming a mixed chaparral on northeast-facing exposures, just outside the RNA boundary. Small areas of *Arctostaphylos* dominance occur on upper due south-facing slopes within the area. Digger pine is not present throughout most of the chaparral, but does occur sporadically in the oak woodland-sage scrub-chaparral ecotones on the mid and lower slopes. One such Digger pine was ca. 3.5 ft. (1.1 m) dbh and had several recent saplings (post-fire) associated with it.

Surprisingly, several small shrubby islands of coast live oak occur on the relatively xeric upper ridge in hollows and drainageways. These trees are obvious resprouts from the recent fire. Coast live oaks also pepper the slopes down into the grassland-sage scrub and oak woodland ecotones. The coverage of these oaks and their limited extent precludes defining a separate plant association for them. However, their presence in this relatively xeric setting approaches the extensive coast live oak woodlands they occur in throughout the hills of the mid- South Coast Ranges.

A periodically maintained fuel break runs up the spine of the ridge. This bare swath is being colonized by several chaparral shrubs, notably *Ceanothus papillosus* and *Pickeringia montana*. It is also home to a number of herbs typical of post-fire and otherwise recently disturbed chaparral. These include: *Galium nuttallii, Camissonia contorta var. epilobioides, Cryptantha microstachys, C. muricata, Baccharis pilularis* var. *consanguinea, Mimulus bifidus, Helianthemum scoparium, Eriodictyon*

tomentosum, Lotus grandiflorus var. *mutabilis, Navarretia squarrosa,* and *Stipa lepida*. The actual diversity and cover of herbs within the main body of chaparral is very low.

Rock Outcrop (no Holland equivalent): The prominent rock outcrops at the Wagon Caves rocks are home to a diversity of rupicolous species (photo 17). The base of these outcrops is a transition zone between adjacent oak woodland and outcrop vegetation. The Rat Fire burned up the west and south sides of the outcrops and actually burned individual shrubs and Digger Pines atop the rocks. The effect of the fire may be seen in the diversity of herbaceous species at the lower transition zone and also in the numerous resprouts of interior live oak and other woody species along the base of the rocks (photo 18).

The following species are typical of the crevices and rock faces of the main outcrop: *Carex brevicaulis, Arctostaphylos pungens, Cercocarpus betuloides, Corethrogyne filaginifolia, Dudleya cymosa* ssp. *minor, Erigeron foliosus* var. *stenophyllus, E. petrophilus, Haplopappus squarrosus, Hieracium argentum var. parishii, Keckiella breviflora, Melica imperfecta* var. *flexuosa, Mimulus bifidus* ssp. *fasciculatis, Pedicularis densiflorus, Pterostegia drymarioides, Selaginella bigelovii,* and *Silene californica*.

Additional species characteristic of the transition area include *Achillea millefolium, Antirrhinum multiflorum, Arenaria douglasii, Clarkia unguiculata, Epilobium paniculatum, Gnaphalium beneolens, G. californicum, Hypochoeris glabra, Lathyrus vestitus, Lonicera interrupta, Phacelia imbricata, Potentilla glandulosa, Rhamnus crocea ssp. ilicifolia, Sambucus mexicanus, Solanum umbelliferum,* and *Toxicodendron diversilobum.*

Riparian Vegetation (61200, 63310): Riparian growth occurs along the North Fork of the San Antonio River, Rattlesnake Creek, Santa Lucia Creek, and a few intermittent stream courses around Wagon Caves rocks. The San Antonio River is subject to heavy flooding in the winter months and exhibits a different physiognomy than the other riparian areas (photo 19). Although much of the riverbed is dry by mid summer, portions of it are flowing or have pools through most of the year. It is lined with a scattered canopy of white alder, California sycamore, and willows (*Salix laevigata, S. melanopsis*). Beneath this tree layer is a intermittent cover of herbaceous

and woody species such as *Apocynum cannabinum, Datisca glomerata, Erigeron philadelphicus, Heleocharis palustris, Boisduvalia densiflorus, Castilleja* sp., and *Mentha spicata*. There are occasional broad gravel and cobble areas which are not dominated by trees. These areas tend to have patches of *Baccharis viminea* and *Eriogonum fasciculatum*. Some areas of former alder and willow dominance have been reduced as a result of the 1985 fire. The dead patches of small trees clearly indicate how the fire leapt the narrow river and ascended the opposite shore.

The riparian situation at Santa Lucia Creek differs from the San Antonio River in that much of the creekbed is dry except during winter floods. The creek traverses the alluvial terrace and has cut a shallow boulder-strewn arroyo averaging ca. 10-15 ft. (3-4.6 m) deep. Along the sides of the arroyo natural levees consisting mostly of large rocks and boulders have built up a few feet above the surrounding terrain. In the arroyo is a scattered woodland dominated by sycamore with some patches of white alders. Above, on the levees is a narrow riparian forest of coast live oak (photo 20). Some of these coast live oaks are large with dbhs of up to 3.5 ft. (1 m) and heights of 65 ft. (20 m). This coast live oak forest is analogous to Holland's central coast live oak riparian forest and is very different from the scattered coast live oaks occurring in the chaparral (see above). A small portion of this same type of forest occurs at the northeastern edge of the RNA along the levees above Rattlesnake Creek.

A small stretch of Santa Lucia Creek at the northwestern corner of the RNA is permanent or semi-permanent. It is dominated by a dense narrow band of white alder. The streambed is lined with *Datisca glomerata, Rubus occidentalis, Woodwardia fimbriata, Rhamnus californicus,* California bay (*Umbellularia californica*), *Salix scouleriana, Psoralea microstachys, Solidago sp., Mimulus guttatus,* and *Stachys pycnantha*.

A few of the deeper drainageways around Wagon Caves rocks contain enough moisture in the early part of the growing season to support limited riparian growth. These channels may be lined with occasional willows (mostly *Salix lasiandra*), *Baccharis viminea, Rubus vitifolius, Rosa californica, and herbs such as Cyperus eragrostis, Carex barbarae, C. densa, Veronica americana, Epilobium adenocaulon, Stachys pycnantha, Urtica holosericea, Gnaphalium palustre,* and *Trifolium varigatum*.

FAUNA

The WCRNA contains a rich diversity of vertebrates. These range from fish such as California roach (*Hesperoleucus symmetricus*) and speckled dace (*Rhinichthys osculus*), amphibians such as foothill yellow-legged frogs (*Rana boylei*) and Pacific tree frogs (*Hyla regilla*), reptiles such as coast horned lizards (*Phrynosoma coronatum*) and common garter snakes (*Thamnophus sirtalis*), to a high diversity of birds (over 60 species reported in appendix 2), and abundant populations of mammals such as California ground squirrels, Merriam chipmunks (*Tamias merriami*), and Botta pocket gophers (*Thomomys bottae*). For a list of all species noted from the area see Appendix 2.

A breeding bird census was conducted in the morning of May 21, 1988. This census was run through the open valley oak savanna from the northeast corner of the RNA to near Wagon Caves. The census covered a strip 1 km long and 100 m wide. A total of 143 individuals of 31 species were recorded in the one hour census. The following species had densities of 1/ha or more: plain titmouse (1.7/ha, 0.7/ac.), starling (1.8/ha, 0.7/ac.), acorn woodpecker (1.3/ha, 0.5/ha), lesser goldfinch (1.2/ha, 0.5/ac.), northern oriole (1.0/ha, 0.4/ac.), and Brewer's blackbird (1.3/ha, 0.5/ac).

In far greater densities than any single species of bird are California ground squirrels. These animals excavate elaborate burrow systems often at the base of mature valley oaks. Judging by the number of individuals associated with individuals large valley oaks, I estimated the densities of this species were about 32/ac. (80/ha) in the open valley oak savanna. This species is known to prey heavily upon acorns of valley oak (Linsdale 1946). Although they gather acorns for caching, these caches are usually deep underground in burrows and thus are unlikely to result in germination as is the case for the caches of tree squirrels (*Sciurus* sp.).

Other acorn predators such as the botta pocket gopher and brush mouse (*Peromyscus boylei*) were noted in the area, however neither had the high densities of the California ground squirrel. Avian acorn predators such as the Acorn woodpecker and scrub jay, though numerous are generally not considered to be as deleterious to the acorn densities as mammals (Koening 1980).

GEOLOGY

The Santa Lucia Mountains are part of the Salinian Block, a large chunk of California which has been displaced northward through the strike/slip movement along the San Andreas Fault. According to Compton (1966) the Junipero Serra quadrangle (the WCRNA lies within the SW 1/4 of this 15' quadrangle), is underlain largely by high-grade metamorphic rocks. These are mainly biotite-feldspar quartzites and quartzo-feldspathic granofelses, amphibolites, aluminous schists, calcite marbles, and metadolomites. Granitic veins and dikes make up 5-15% of most outcrops and average over 50% throughout large areas. The age of these high grade metamorphics and granitic rocks are Cretaceous (ca. 69.6-75 my).

Although the above rocks are the basement series in the area, they do not outcrop within the RNA. The only evidence of the granitic and gneissic basement rock is the massive Quaternary alluvial terrace and stream deposits associated with the three streams in the area. The most conspicuous rocks in the RNA are shale and sandstone. These rocks are younger than the basement series. They make up the overlying blanket of Cenozoic shelf, slope and land deposits mapped in Page (1966).

The most conspicuous of the Cenozoic sediments is the sandstone which composes the Wagon Caves. This Paleocene rock (Jennings et al. 1977) is a thick bedded arkosic sandstone which has occasional small cobbles of basement schist, and granitic rocks. It weathers to rounded massive boulders and creates narrow caves and overhangs along bedding planes. Associated with the sandstone at Wagon Caves is a thin evenly bedded shale with small partings of mudstone. This is exposed along the small bluffs above the North Fork of the San Antonio River, just west of Wagon Caves. According to the map of Jennnings et al. (1977) this is also Paleocene in age.

The shale and band of sandstone on the northeastern boundary ridge are Miocene (Jennings et al. 1977). The pale silicious shale which composes the majority of the upper ridge is similar if not analogous to the Monterey Formation (Page 1966). The band of sandstone along the lower base of the ridge (see photo 16) is similar to Vaqueros sandstone, which is known to underlie the Monterey Formation in the eastern Santa Lucia Mountains (Page 1966).

SOILS

The soils of the WCRNA may be divided into eight mapping units. The brief descriptions of these units that follow are excerpted from the Soil Survey of Monterey County (U.S.D.A.-U.C. Agricultural Experiment Station 1978). Their distribution is shown in map 4. They are arranged in descending order of areal coverage.

San Andreas fine sandy loam, 15-30% slopes: This unit consists of well drained soils on hilly land underlain by sandstone. It is the dominant type throughout the central portion of the area and underlies the blue oak woodland and the lower and middle slopes of the northeastern boundary ridge. A typical profile indicates depth to weathered bedrock of about 20-40 inches (51-102 cm). Runoff is rapid and the erosion hazard is moderate as evidenced by the numerous dendritic drainageways. Roots can penetrate to a depth of 30-40 inches (76-102 cm).

Arroyo Seco gravelly sandy loam 5-9% slopes: This is the soil underlying the well developed open valley oak woodland. It is made up of well-drained soils formed from granitic alluvium on alluvial fans and plains. In a representative profile the depth to rocky alluvium was 60 inches (152 cm). Coarse rock fragments (cobbles and stones) make up 10-35% of the A horizon and the C1 horizon is gravelly sandy loam with 15-35% gravel and cobbles. Runoff is medium and the erosion hazard is moderate.

Santa Lucia-Reliz association: This soil unit underlies the steeper upper slopes of the northeastern ridge. It is underlain by hard shale of the Monterey Formation. The majority of the soils in this unit occurring at WCRNA are probably Reliz association. The description in the soil survey indicates there may be some inclusions of Lopez soils on ridgetops and slopes with southern exposures and there may also be some Chamise, Gazos, Nacmiento, San Benito, and Los Osos soils. The typical Reliz soil has a depth of ca. 12-20 inches (30-51 cm) to fractured bedrock. Roots can penetrate to a depth of 10-20 inches (25-51 cm). Runoff is rapid and the erosion hazard is high.

Santa Ynez fine sandy loam, 2-9% slopes: This unit underlies the very open valley oak savanna and grassland in the east central portion of the area. It occupies the gently sloping terrace deposits underlain by granitic alluvium.

The surface layer is about 20-30 inches (51-76 cm) thick and depth to cobblestones and gravel is often over 60 inches (152 cm). Compared to the adjacent Arroyo Seco Soils this soil has fewer and smaller cobbles and rocks, the average size being ca. 2-10 mm. Runoff is slow or medium and the erosion hazard is slight or moderate. Roots can generally penetrate to a depth of 60 inches (152 cm) or more.

Lockwood shaley loam, 9-15% slopes: This soil occurs locally in the west-central portion of the area. It is a well drained soil that formed in alluvium derived from siliceous shale (Monterey Formation, locally). It is vegetated with grassland and young valley oak woodland. The surface layer is shaley clay loam in some places. The soil contains 45-50% gravel and 10-20% cobbles. Runoff is slow or medium and the erosion hazard is moderate. Depth to the B2 horizon is commonly 36-45 inches (91-114 cm).

Rock outcrop: This mapping unit is represented at the Wagon Caves sandstone outcrops.

Psamments: This mapping unit consists of undulating areas of stratified sandy, gravelly and cobbly sediments on the flood plain of the North Fork of the San Antonio River.

Fluvents, Stony: This land type consists of nearly level to strongly sloping stony and cobbly areas in drainageways and alluvial fans. It is locally represented in the creekside of Santa Lucia and Rattlesnake creeks. Drainage is excessive and permeability is usually very rapid. The erosion hazard is moderate because of channeling and deposition. Roots can penetrate to a depth of 36-60 inches (91-152 cm).

Haire loam, 15-30% slopes: This unit occurs locally immediately southeast of the Wagon Caves outcrops. It is a moderately steep soil derived from arkosic sandstone. Depth to weathered bedrock is 20-30 inches (51-76 cm). Runoff is medium to rapid and erosion hazard is moderate to high. This area is dominated by blue oak woodland.

CULTURAL VALUES

The Salinian peoples occupied the region between Soledad and San Luis Obispo from the coast to the crests of the Inner Coast Ranges. At the time of European contact the population was estimated to be about 3000 (Hester

1978). In the late 1700's Mission San Antonio was an important center for the Salinan, who were described as friendly and charitable. However by 1842 only 30 Salinans remained there. In the early 1900's there were only three Salinan families living in the vicinity of the mission and Jolon. In 1933 there were only four surviving members of the northern group of Saninans, the so called Antoniano division. The Antonianos were the people living in the vicinity of Wagon Caves.

According to the map of village locations in Hester (1978) the WCRNA may have had two Salinan village sites within or adjacent to it. The village of Papuco was located near the junction of the main and North Fork of the San Antonio, and the village of Tilacusam was located near the present day location known as The Indians. Both of these sites are within 2 miles of the RNA. According to Hester (1978) very little information on settlement pattern, and prehistory is available. Salinan culture is now ethnologically extinct.

Acorn collection was very important and hunted mammals included deer, bear, and rabbits. By the time of European contact wild oats (*Avena*) sage seeds, berries, mescal (*Yucca*) and wild fruits were regularly utilized.

The shallow overhangs and caves at Wagon Caves have fire scarred roofs. There are several bedrock mortar sites associated with the caves and on horizontal slabs of sandstone adjacent to the valley oak savanna. It is likely that the area were regularly used and the the valley oak groves undoubtedly provided a useful foraging ground.

IMPACTS

Recreation:
The main county road that passes through the proposed RNA brings much traffic. It is a paved road and may be traveled all year in the vicinity of the RNA. During the three day period of my visit in May 1988 I noted over 20 visitors who actually stopped within the RNA and a number of other cars passing through. The chief activity of those who stopped in the area appeared to be shooting. At least 10 people were seen to fire guns within the RNA and the numbers of shell casings and damaged bark to valley and coast live oaks throughout the area (particularly in the southern and eastern

portions) indicated that target shooting is a regular activity. Other important activities included camping at the several unimproved sites along the dirt tracks off the main road, fishing (and associated beer drinking and beer can littering) at the North Fork of the San Antonio River, and rock climbing on Wagon Caves.

In short, this area is the most heavily used candidate I have ever visited. Despite this use, the natural qualities and values of the area are high and many, and replacements are not available. Management should consider this heavy use by the public.

Grazing:
The Wagon Caves area has been grazed since the missionary days of the late 1700's. It is presently on the upper Milpitas Allotment. This is a 2200 acre (891 ha) allotment which was acquired by the Forest Service in 1954 following Army (Hunter-Liggett) use. The entire RNA is within this allotment.

A review of the allotment records at the District Ranger Office in King City indicates that in general, forage condition is good and has improved since before 1975. Soil condition is high-fair (dropped a bit since pre-1975 due to the 1975 Indians Fire). In the center of the RNA there has been an intense use of ca. 15 acres (6 ha). There has been sustained yield of *Bromus mollis* and *Avena* sp.

The season is from April 1 to July 31. However there is also light year-round use by Forest Service stock (horses and mules). In recent years there have been 275-300 head of cattle on the allotment with AUM of 1,584 (1979 estimate). A report on the condition of the allotment in 1986 and 1987 mentions that milk thistle (*Silybium marianum*) and star thistle (*Centaurea melitensis*) are invading due to late and unauthorized grazing in summer and early fall. This same report indicates that some riparian areas are heavily grazed with any further grazing having serious impact on wildlife feed. Apparently fences on the southern side of the allotment need repair. The 1987 report recommends that cattle should be removed no later than June 25.

During my visit I noticed about 30 head of cattle using the RNA. They ranged throughout the savanna area. Well-warn cattle trails exist in the dendritic

drainageways leading down to the North Fork of the San Antonio River. The areas of heaviest impact were in the riparian zone of the San Antonio River and in localized patches in the savanna-grassland in the central portion of the RNA. The savanna area along the eastern side had not yet been heavily grazed by the time of my visit. The condition of several species of native grasses in the central portion of the RNA had been clearly affected by cattle grazing (see photo 7). Both *Stipa cernua* and *Muhlenbergia rigens* were grazed to within an inch or two of the ground in certain areas.

MANAGEMENT CONCERNS

Foremost on the list of management concerns for this candidate RNA are recreational conflicts, enrichment and maintenance of native grassland, and grazing.

The evidence from recent studies, as well as tentative evidence from the Wagon Caves area suggests that periodic burning in the summer or fall encourages diversification of grassland species while reducing cover of dominant introduced species such as *Bromus diandrus* and *Avena* sp. (Parsons and Stohlgren 1989). Heady (1977) indicates that complete absence of livestock is about the only situation that sometimes permits the re-invasion of native perennial grasses. Apparently winter grazing is less likely to reduce cover of native bunchgrasses than spring to fall grazing (Heady 1977).

From the above information it seems wise to remove grazing from the RNA and to develop a fire prescription for the grassland and savanna-woodland areas of WCRNA. Because of the dangers of a conflagration in summer, fires should probably be set in fall. According to Parsons and Stohlgren (1989) spring burns are not as effective in reducing the cover of annual grasses and do not increase diversity as well as fall fires. The periodicity of fires should be determined through small experimental burns. As indicated by the natural burn in 1985, three years later the effects of increased diversity of annual species and vigor of native perennial grasses were still noticeable.

Fences already exist around much of the RNA. Thus, cattle grazing could be easily excluded with the addition of a fence closing off the western boundary at Santa Lucia Creek.

The most difficult management problem will be to effectively deal with the recreational use. Clearly high levels of shooting, camping, off-road travel, etc. are not compatible with RNA designation. The main road passing through the area will undoubtedly remain, but there may be some way to limit travel on the unmaintained dirt roads. Fencing both sides of the county road where it passes through the proposed boundaries, in conjunction with sturdy gates on the side roads, may be the best option.

RECOMMENDATIONS

I strongly recommend the establishment of the Wagon Caves RNA. Despite its management difficulties, the valley oak habitat is in critically short supply and is very well represented in this area. The diversity of the grassland with its high number of native species is unusual and also signifies the great value of this area. With careful consideration and management, this area could become a useful RNA, exemplary of an ecosystem that is has been strongly altered and reduced throughout the California region.

Boundary Options:
The original proposal submitted by the Los Padres N.F. indicates the size of the WCRNA as about 150 acres (61 ha) (with the same boundaries as defined in this report). However, the map accompanying the proposal shows an area of ca. 546 acres (221 ha), about 1/3 of which is steep chaparral and sage scrub. This leaves about 366 acres (148 ha) of oak woodland and grassland. The minimum size accepted for RNAs is 300 acres (121 ha). Because the area may represent the only valley oak target in the PSW RNA system and because it contains some of the best examples of native grassland in any proposed RNA, it is important to maximize the protective value of the RNA.

With this in mind, I suggest that several boundary options be considered to increase the size of the RNA for establishment. Across from the present western boundary (Santa Lucia Creek) and south of County Route 4050 is extensive valley oak savanna on Arroyo Seco soils, similar to that which is represented in the RNA. If the area between the present western boundary and the private land at The Indians was included this would approximately double the size of the target element. Valley oak savanna also exists on

Forest Service land southeast of the junction of Rattlesnake Creek and the San Antonio River. If an agreement with the Hunter-Liggett Military Reservation could be made for joint management of a valley oak RNA, much additional oak woodland (both blue oak and valley oak) could be included adjacent to the proposed southeastern boundary. Map 5 indicates some of the possible additions.

The boundaries shown in map 2 differ somewhat from the original proposal (see map 5). I have included the Wagon Caves rocks as part of the RNA because the riparian vegetation south and southwest of the rocks is well developed and because the rocks themselves have an interesting and well developed cliff and crevice vegetation, some good patches of native grassland, and merrit as a cultural site. I have also included the entire portion of valley oak savanna on the eastern side of the area adjacent to Rattlesnake Creek. The original proposal cut this open savanna in half, excluding the portion east of the unimproved dirt track leading up to the edge of Rattlesnake Creek at the foot of the northeastern boundary ridge. Apparently this division was made because of a boundary line error made on the 7.5 minute topographic map (Cone Peak 1972 edition). The actual boundary of Forest Service land as indicated on the most recent Los Padres National Forest administrative map (1984 edition) shows the Forest Service boundary in this area along the creekbed of Rattlesnake Creek.

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APPENDIX 1
VASCULAR PLANT LIST

The following list includes all species identified during the field work for this ecological survey (May 20-23, 1988). Taxonomy follows Munz (1968) and Howett and Howell (1964, 1973). About 230 taxa are included. The following abbreviations refer to habitat types noted for the plants:

vo.....valley oak woodland
bo.....blue oak woodland
clo.....coast live oak riparian forest
ro.....rock outcrop
ri.....riparian vegetation
cc.....chamise chaparral
ss.....sage scrub

Achillea millefolium ; ro, bo
Adenostoma fasciculatum ; cc
Aesculus californicus ; rare bo
Agoseris heterophylla ; burned bo
Agoseris retrorsa ; bo, vo
Agrostis semiverticellata ; ri
Aira caryophyllaea ; swales, bo
Alnus rhombifolia ; ri
Amsinkia intermedia ; vo, bo
Anagalis arvensis ; ro, bo
Antirrhinum multiflorum ; ro
Apocynum cannabinum var. *glaberrimum* ; ri
Arctostaphylos glandulosa ; cc, common
Arctostaphylos pungens ; ro, occasional bo
Arenaria douglasii ; ro
Artemisia californica ; ss
Artemisia dracunculus ; bo, swales
Asclepias californica ssp. *greenei* ; vo
Asclepias fascicularis ; moist swales vo, bo
Astragalus douglasii ; bo, ro
Avena barbata ; common grassland, vo, bo,ss
Avena fatua ; occasional vo, grassland
Baccharis pilularis var. *consanguinea* ; cc fuel break
Baccharis viminea ; ri (San Antonio R.)
Boisduvalia densiflora ; ri (San Antonio R.)

Boisduvalia glabella var. *campestris* ; wet swale
Brassica nigra ; vo, grassland
Brickelia californica ; cc fuel break, ri Santa Lucia Cr.
Brizia minor ; moist swale
Brodiaea jolonensis ; vo, bo fairly common
Bromus arenarius ; vo
Bromus carinatus ; scattered vo, cc
Bromus diandrus ; common shade of vo
Bromus madritensis ; occas., vo
Bromus mollis ; very common vo, bo
Bromus rubens ; common vo, grassland
Calochortus splendens ; bo, vo
Camissonia contorta var. *epilobioides* ; cc fuel break
Camissonia dentata var. *campestris* ; vo
Carex barbarae ; ri, wet swale
Carex brevicaulis ; ro
Carex densa ; wet ri and swales
Carex tumicola ; occas. semi-shade bo, vo
Castilleja stenantha ; ri (San Antonio R.)
Caucalis microcarpa ; bo, vo, common semi-shade
Ceanothus papillosus ; cc fairly common
Ceanothus cuneatus ; cc, uncommon
Centaurea melitensis ; vo, bo, common
Cercocarpus betuloides ; ro
Chorizanthe membrenacea ; bo, vo, grassland occasional
Chorizanthe palmeri ? ; prob this sp. (not in flower) in bo
Chorizanthe staticoides ; bo, showy
Cirsium californicum ; cc, lavender
Cirsium protianum ; common vo , rose-red
Clarkia epiloboides ; vo-clo ecotone
Clarkia purpurea ssp. *quadrivulnera* ; vo, grassland
Clarkia rhomboidea ; open vo, bo, grassl
Clarkia unguiculata ; bo, vo, ro
Clematis lasiantha ; cc
Convolvulus malacophyllus ssp. *pedicellatus* ; grassland-ss ecotone
Corethrogyne filaginifolia ; ro, bo
Cryptantha microstachys ; cc fuel break
Cryptantha muricata ; cc fuel break
Cyperus eragrostis ; wet swale

Datisca glomerata ; ri (Santa Lucia Cr.)
Daucus pusillus ; very common vo, bo
Delphinium parryi ssp. *seditiosum* ; vo, near type locality
Delphinium parryi ; vo, bo, common
Dendromecon rigida ; cc
Dudleya cymosa ssp. *minor* ; ro, ss, both orange (Wagon Caves) and yellow forms (eastern ridge)
Elymus glaucus ; vo occasional
Epilobium paniculatum ; bo, ro
Epilobum adenocaluon ; wet swale, ri
Eremocarpus setigerus ; vo, bo summer
Erigeron foliosus var. *stenophyllus* ; ro
Erigeron petrophilus ; ro
Erigeron philadelphicus ; ri (San Antonio R.)
Eriodictyon tomentosum ; cc
Eriogonum fasciculatum ; ri dry alluvium, San Antonio R.)
Eriogonum elongatum ; cc occasional
Eriogonum nudum ; vo, bo
Eriophyllum confertiflorum ; bo, ss
Erodium botrys ; vo, ro early spring
Erodium cicutarium ; common grassland, vo, bo
Filago californica ; bo
Filago gallica ; vo, occasional
Galium andersonii ; cc, bo shallow soil
Galium aparine ; swales under bo, vo
Galium californicum ; cc
Galium nuttallii ; cc, showy bloomers in ss
Galium trifidum var. *subbiflorum* ; shaded swale in bo
Geranium molle ; vo common in semi-shade
Gnaphalium beneolens ; ro-bo ecotone (burned)
Gnaphalium californicum ; ro
Gnaphalium palustre ; wet swale
Haplopappus squarrosus ; ro
Heleanthemum scoparium var. *vulgare* ; ro, fuel break cc
Heleocharis palustris ; ri (San Antonio R.)
Heleotropium curassivicum var. *oculatum* ; grassland, uncommon
Hemizonia lobbii ; late summer vo, bo
Heteromeles arbutifolia ; cc
Hieracium argentum var. *parishii* ; ro

Hordeum leporinum ; vo disturbed
Hordeum geniculatum ; moist swales
Hordeum californicum ; swale
Hypochoeris glabra ; ro, bo
Juncus balticus ; vo
Juncus mexicanus ; wet swale
Juncus patens ; swales, rivulets
Keckiella breviflora ; ro, ss
Koeleria macrantha ; vo, bo, fairly common
Lagophylla congesta ; bo, occas. vo
Lagophylla ramosissima ; bo
Lasthenia leptalea ; vo, grassland
Lathyrus vestitus ; ro, (burned)
Layia ??; alt glandular leaves? cc
Layia paniculata ; cc fuel break
Linanathus liniflorus ; very common, displays in grassland and open vo
Linanthus ciliatus ; common grassland and open vo
Lolium multiflorum ; vo
Lomatium caurifolium ; bo, occasional
Lonicera interrupta ; occasional ro, bo
Lotus grandiflorus var. *mutabilis* ; common on fuel break in cc
Lotus purshianus ; common vo
Lotus purshianus ; varient w/ reddish pilose foliage and small leaves, vo
Lotus scoparius ; ss, cc, common
Lotus sp.; vo strigose annual w/ straight pods
Lotus subpinnatus ; vo, bo, grassland
Lupinus albifrons ; ss-grassland
Lupinus bicolor ssp. *microphyllus* ; bo,vo
Lupinus concinnus var. *agardhianus* ; rocky alluvium ri
Lupinus formosus ; vo
Lupinus latifolius ; vo on ridge slope
Lupinus luteolus ; bo
Lupinus nanus ; vo, common early flower
Madia exigua ; bo, grassland, common
Madia gracilis ; bo, vo, occasional
Marah fabaceus ; cc
Marrubium vulgare ; vo distubed
Matricaria matricarioides ; road beds in vo
Medicago hispida ; swales, vo
Melica californica ; vo, bo, cc-grassland, fairly common

Melica imperfecta var. *flexuosa* ; ro, grassland, ss
Mentha spicata ; ri (San Antonio R.)
Micropus californicus ; vernally moist grassland, vo
Mimulus bifidus ssp. *fasciculatus* ; ss,ro
Mimulus guttatus ; ri, base of Wagon C.
Monardella villosa; ss
Montia perfoliata ; vo shade
Muhlenbergia rigens ; vo, bo, ss, clo, grassland
Navarretia atractyloides ; bo, vo occasional
Navarretia squarrosa ; cc fuel break
Orthocarpus densiflorus ; vo, bo
Pedicularis densiflorus ; ro
Pellaea andromedaefolia ; ss
Pellaea mucronata ; ro, cc
Phacelia imbricata ; ro
Phacelia ramosissima ; ss
Pholistoma auritum ; ro, ss
Phoradendron flavescens var. *villosum* ; vo
Pickeringia montana ; cc, fuel break
Pinus sabiniana ; bo, clo-cc ecotone
Pityrogramma triangularis ; arroyo bo
Plagiobothrys nothofulvus ; edge of moist swale
Plantago hookeriana var. *californica* ; ss, upland grassland
Platanus racemosa ; ri
Poa howellii ; vo, bo less common
Poa scabrella ; fairly common vo, bo
Polypodium californicum; ro
Polypogon monspeliensis ; swales, ri
Potentilla glandulosa ; ro, ri
Psoralea macrostachya ; ri
Pterostegia drymarioides ; ro
Quercus agrifolia ; clo, ri
Quercus douglasii ; bo
Quercus dumosa ; cc (intergrades w/ *agrifolia* and *lobata*)
Quercus lobata ; vo
Quercus wislizenii ; ro-bo ecotone
Ranunculus californicus ; swales, bo,vo
Rhamnus californicus ; ri, uncommon
Rhamnus crocea ssp. *ilicifolia* ; bo, ro

Rigiopappus leptocladus; common open vo, grassland
Rosa californica; ri, wet swale
Rubus occidentalis ; ri (Santa Lucia Cr.) dominant understory shrub, not reported for Santa Lucia Mtns.
Rubus vitifolius ; wet swale
Rumex crispus ; ri, swales
Salix laevigata ; ri(San Antonio R.), wet swale
Salix melanopsis ; ri (San Antonio R.)
Salix scouleriana ; ri (Santa Lucia Cr.)
Sambucus mexicanus ; ro, bo
Sanicula bipinnatifida ; bo occasional
Sanicula crassicaulis ; vo, bo, common
Scribneria bolanderi ; bo, near rivulets
Selaginella bigelovii ; ro, ss
Senecio douglasii ; cc, fuel break, rare
Sidalcea malviflora ssp?; semi-shade vo
Silene californica ; ro
Silene gallica ; occas. bo (burned)
Silybum marianum ; disturbed vo
Sitanion jubatum ; scattered bo, vo
Solanum umbelliferum ; ro
Solidago sp.; ri (Santa Lucia Cr.)
Sonchus asper ; wet swale
Stachys bullata ; dry ecotone cc-grassland
Stachys pycnantha ; ri (Santa Lucia Cr.)
Stellaria media ; vo shade
Stephanomeria virgata ; ro, cc, ss
Stipa cernua ; common open vo, bo, grasslands
Stipa lepida ; cc (fuel break)
Stylocline gnaphaloides ; open vo, bo
Thysanocarpus curvipes ; vo, bo
Torilis japonica ; vo
Toxicodendron diversilobum ; ro, ri, clo
Trichostema lanceolatum ; vo, late summer
Trifolium albopurpureum ; bo
Trifolium microcephalum ; ri
Trifolium repens ; swales, not common
Trifolium tridentatum ; vo, occasional
Trifolium varigatum ; swales, common
Umbellularia californica ; ri (Santa Lucia Cr.)

Urtica holosericea ; wet swale, ri
Urtica urens ; vo disturbed semi-shaded areas
Verbena leucostachys ; occasional vo
Veronica americana ; wet swale
Viola pedunculata ; vo
Vulpia dertonensis ; vo, very common in bo
Vulpia grayi ; occasional bo, vo, grassland
Vulpia myuros ; common bo, vo
Woodwardia fimbriata ; ri (Santa Lucia Cr.)
Yucca whipplei var. *percursa* ; ss
Zauschneria californica ssp. *mexicana* ; ro, cc, ss

APPENDIX 2
VERTEBRATES NOTED FROM WAGON CAVES CANDIDATE RNA

This list is largely limited to species noted from the area during the field work for this survey in May 1988. A few additional species of birds are listed on the basis of observations on November 11, 1989. Only two species, the turkey and the ferral pig have been included on the basis of introduction reports on file with the Ranger District at King City. Numbers in parentheses following some bird names represent numbers tallied on a 10 ha belt census conducted May 21, 1988 in the open valley oak savanna. Abbreviations following the species names refer to habitats as they are abbreviated in Appendix 1. Authorities for names are given following each class heading.

Fish (Moyle 1976):
California roach (*Hesperleucus symmetricus)*; Santa Lucia Cr.
Speckled dace (*Rhinichthys osculus*); San Antonio R.

Amphibians (Stebbins 1985):
Pacific tree frog (*Hyla regilla*); swales, ri
Foothill yellow-legged frog (*Rana boylei*); ri (San Antonio R.)

Reptiles (Stebbins 1985):
Western pond turtle (*Clemmys marmorata*); swale, drainage channel near San Antonio R.
Western fence lizard (*Sceloporus occidentalis*); vo
California whiptail (*Cnemodophorus tigris*); ri, vo, cc
Northern allegator lizard (*Gerronhotus coeruleus*); cc
Coast horned lizard (*Phrynosoma coronatum*); cc
Common garter snake (*Thamnophus sirtalis*); swale near San Antonio R.

Birds (Robbins et al. 1983):
Mallard; ri (San Antonio R.)
Turkey vulture; overhead
Red-tailed hawk; overhead, ro
Golden eagle; flying over Wagon Caves rocks Nov. 11, 1989

Cooper's hawk; flying over vo savanna Nov. 11, 1989
American kestrel; vo, grassland
Turkey; introduced in area according to records at R.D.
Common snipe; swale adjacent to Wagon Caves Nov. 11, 1989
California quail; (1) occasional cc, vo, ri
Mountain quail; cc, ro
Mourning dove; (4) common vo, bo, ri
Band-tailed pigeon; (6) common vo
Great horned owl; 3-4 scared out of caves at Wagon Caves rock escarpement
Barn owl; vo (open savanna)
White-throated swift; overhead throughout especially ro
Anna's hummingbird; (1) vo, cc, ri
Black-chinned hummingbird; common ro, cc, bo
Acorn woodpecker; (13) very common vo, bo
Common flicker; (3) vo, bo, ri
Nuttall's woodpecker; (3) vo, bo, ri
Downy woodpecker; ri (Santa Lucia Cr.)
Ash-throated flycatcher; (5) common vo, cc, bo
Western kingbird; (1) vo, grassland
Olive-sided flycatcher; ri (Santa Lucia Cr.)
Western flycatcher; ri (Rattlesnake Cr.)
Black phoebe; ri, nesting in culvert (Santa Lucia Cr.)
Violet-green swallow; (5) common vo (nest holes), ri, overhead
Cliff swallow; ro, ri
Scrub jay; (1) common bo, vo, cc
Steller's jay; (1) uncommon clo, Rattlesnake Cr.
Plain titmouse; (17) very common vo, bo, cc
Bushtit; bo, cc
White-breasted nuthatch; (8) very common vo, bo
House wren; (2) occasional vo, bo, ri
Canyon wren; nest in Wagon Caves rocks
Bewick's wren; ro, cc
Blue-gray gnatchatcher; (4) vo, bo, cc
Ruby-crowned kinglet; common bo, Nov. 11, 1989
Robin; (4) common, vo, ri, bo
Western bluebird; (1) fairly common vo, bo, ri, ro
Wrentit; cc
Phenopepla; (2) vo
Starling; (18) very common vo, grassland

Solitary vireo; (1) vo occasional
Warbling vireo; ri (Rattlesnake Cr. Santa Lucia Cr.)
Black-throated gray warbler; cc
Orange-crowned warbler; cc
Nashville warbler; ri, clo (Santa Lucia Cr.)
Wilson's Warbler; ri (Santa Lucia Cr.)
Yellow warbler; ri (San Antonio R.)
Black-headed grosbeak; ri, cc
Lazuli bunting; cc
Rufous-sided towhee; (1) cc, vo, ri
Brown towhee; (1) ri, cc, vo ecotone
Western meadowlark; grassland
Brown-headed cowbird; (1) grassland, vo
Brewer's blackbird; (13) common grassland, vo, ri
Northern oriole; (10) common vo, ri
Dark-eyed junco; (1) vo, grassland
Chipping sparrow; (1) vo, bo
Lark sparrow; vo, ss
Golden-crowned sparrow; common Nov. 11, 1989
Lesser goldfinch; (12) common vo, bo, ri, cc
House finch; (1) occasional vo, ri
Purple finch; vo, occasional

Mammals (Jameson and Peeters 1988):
Feral pig (*Sus scrofa*); introduced in area according to records at R.D.
Botta pocket gopher (*Thomomys bottae*); common vo, bo, grassland
Dusky-footed woodrat (*Neotoma fuscipes*); middens and nests common in Wagon Caves rocks
California ground squirrel (*Spermophilus beecheyi*); very common grassland, vo, bo
Brush mouse (*Peromyscus boylii*); ri, vo, clo ecotone (trapping success 8.3%)
Brush rabbit (*Sylvilagus bachmani*); cc
Gray fox (*Urocyon cinereoargenteus*); cc (scat)
Coyote (*Canis latrans*); cc (scat)
Black-tailed deer (*Odocoileus hemionus*); cc, vo
Merriam chipmunk (*Tamias merriami*); cc, vo

CAPTIONS FOR PHOTOS

Photo 1: View looking north through the open valley oak savanna on the eastern side of the RNA.

Photo 2: Mature, healthy valley oak in the open savanna. This specimen is 53" dbh and 80 ft. tall.

Photo 3: Dense young valley oak bordering a swale in the west central portion of the area. Note climbing shrubs of *Toxicodendron diversilobum*. Swale bottom is dominated by *Juncus mexicanus*.

Photo 4: View northeast through relatively dense, young valley oak stand. Trees in background are a little under 100 years old.

Photo 5: View looking north from the top of Wagon Caves Rocks over a very open valley oak savanna and adjacent grassland.

Photo 6: Old, senescent valley oak with ground squirrel disturbance at its base. Tree is ca 74" dbh. Green herb at base is *Urtica urens*.

Photo 7: Upland valley oak and blue oak savanna. Green grass in foreground is heavily grazed *Muhlenbergia rigens*. Note snag of ancient valley oak in mid-distance.

Photo 8: Overview of blue oak woodland west of Wagon Caves rocks. Photo taken from northeastern boundary ridge looking south.

Photo 9: Typical blue oak woodland in central portion of RNA.

Photo 10: Two large blue oaks. Specimen on left is ca. 3 ft. dbh and 70 ft. tall. Wagon Caves in background.

Photo 11: View of grassland adjacent to open valley oak savanna. Tall fruiting grass in foreground is *Stipa cernua*.

Photo 12: Well-developed native component to grassland adjacent to blue oak woodland. This grassland was burned in summer 1985. Dominant species include *Stipa cernua, Poa scabrella, Avena* sp. and *Lagophylla*

ramosissima.

Photo 13: Overview of wildflower field adjacent to dense young valley oak woodland. Dominant pink flower is *Linanthus liniflorus*.

Photo 14: Detail of wildflower field type of grassland. Dominants include *Linanthus liniflorus, L. ciliatus, Clarkia purpurascens, Daucus pusillus,* and *Lotus subpinnatus*.

Photo 15: *Chorizanthe staticoides* (Turkish rugging) a showy species which locally dominates wildflower fields adjacent to blue oak woodland.

Photo 16: Sandstone outcrop associated with *Artemisia californica* and other sage scrub species along the base of the northeastern boundary ridge.

Photo 17: View overlooking a portion of Wagon Caves rocks with associated cliff and crevice vegetation. Photo is facing northeast with chamise chaparral-topped boundary ridge in background.

Photo 18: Western escarpment of Wagon Caves rocks showing recently burned and resprouted interior live oak and other species.

Photo 19: Riparian situation at North Fork of the San Antonio River near the northwest base of the Wagon Caves rocks.

Photo 20: Riparian woodland along the banks of Santa Lucia Creek showing fringing forest of coast live oak with sycamore and white alder along the central moist portion.

PHOTO #1

PHOTO # 2

PHOTO #3

PHOTO #4

PHOTO # 5

PHOTO #6

PHOTO #7

PHOTO #8

PHOTO #9

PHOTO # 10

PHOTO #11

PHOTO #12

PHOTO #13

PHOTO #14

PHOTO #15

PHOTO #16

PHOTO #17

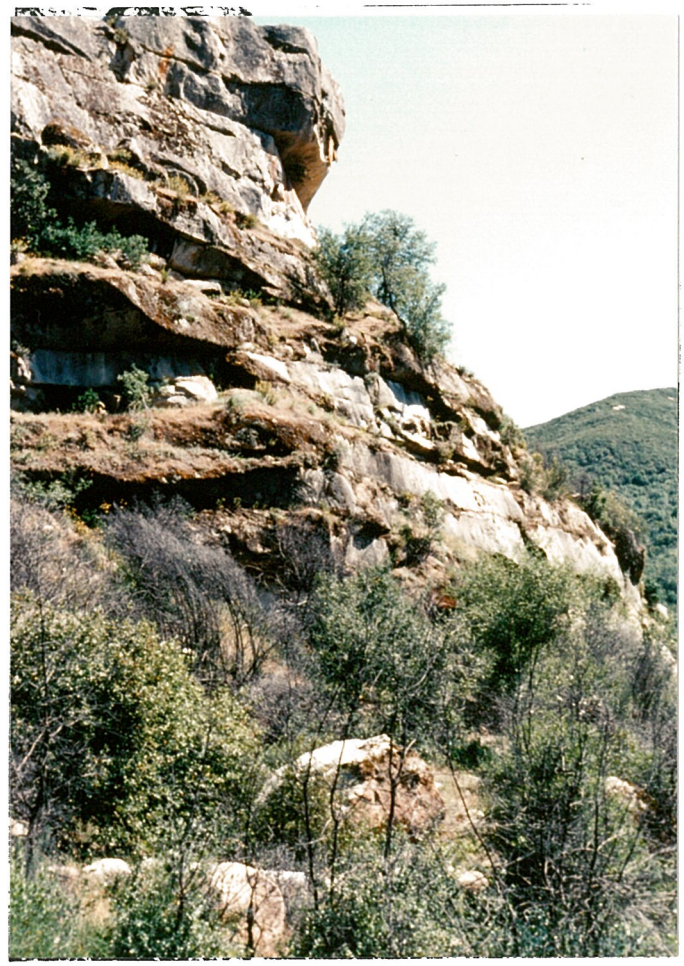
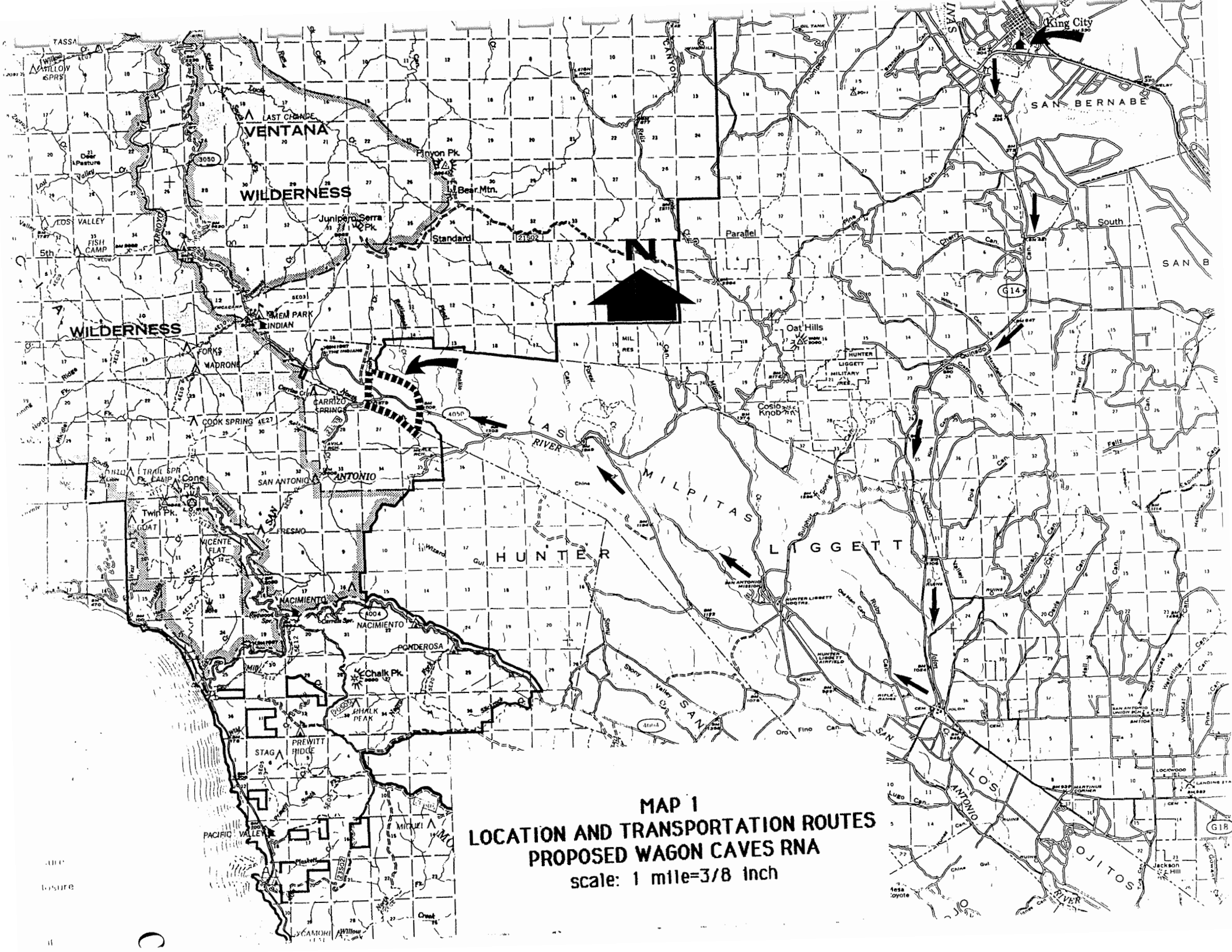


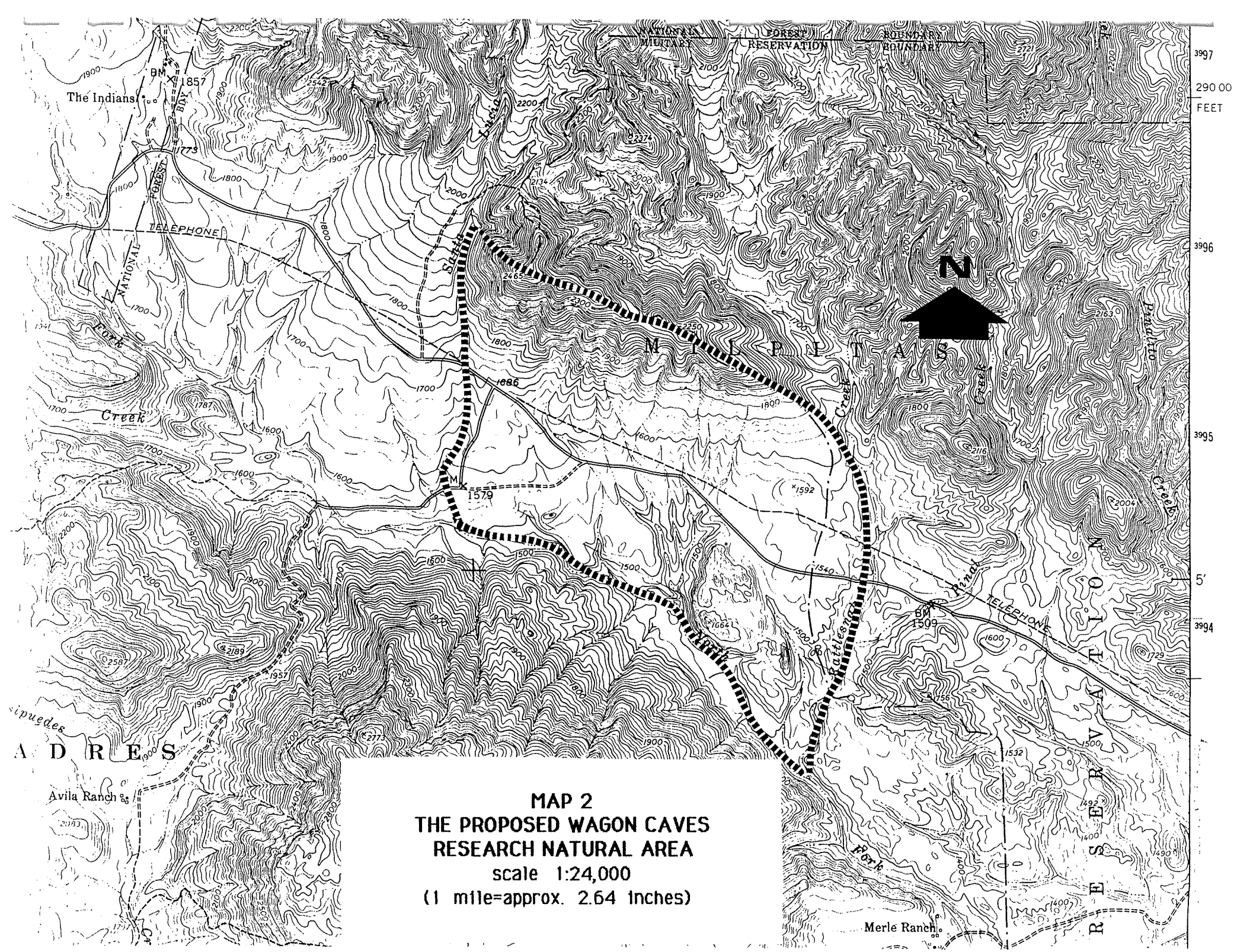
PHOTO #18

PHOTO #19

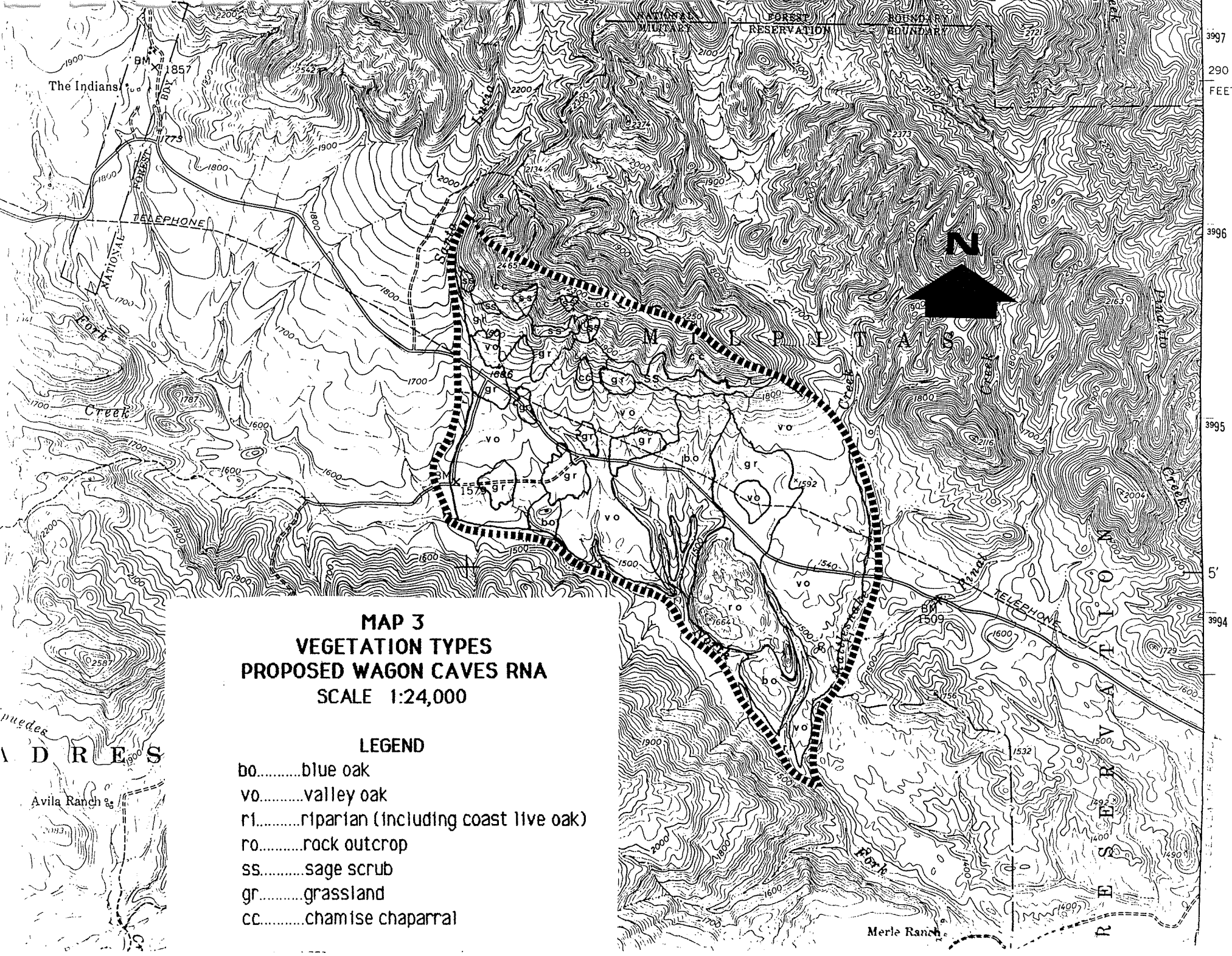
PHOTO #20

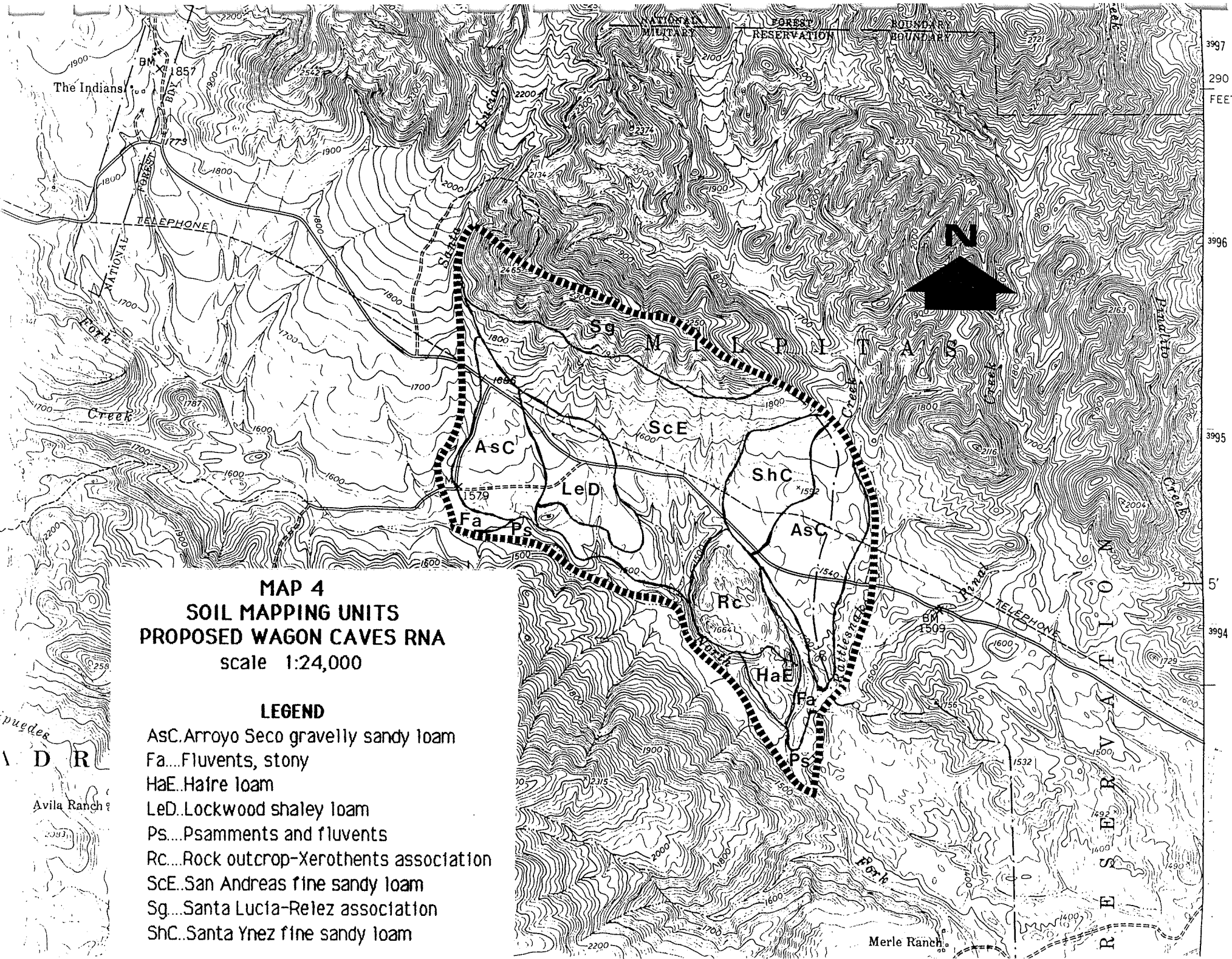


MAP 1
LOCATION AND TRANSPORTATION ROUTES
PROPOSED WAGON CAVES RNA
scale: 1 mile=3/8 inch



MAP 2
THE PROPOSED WAGON CAVES
RESEARCH NATURAL AREA
scale 1:24,000
(1 mile=approx. 2.64 inches)


MAP 3
VEGETATION TYPES
PROPOSED WAGON CAVES RNA
SCALE 1:24,000
LEGEND
bo.....blue oak
vo.....valley oak
ri.....riparian (including coast live oak)
ro.....rock outcrop
ss.....sage scrub
gr.....grassland
cc.....chamise chaparral
N
MILITARY RESERVATION
FOREST BOUNDARY
The Indians
TELEPHONE
Avila Ranch
Merle Ranch
Rattlesnake Creek
Pinal
Pauilito Creek
Fork
Creek
3997
290 00
FEET
3996
3995
5'
3994


MAP 4
SOIL MAPPING UNITS
PROPOSED WAGON CAVES RNA
scale 1:24,000
LEGEND
AsC..Arroyo Seco gravelly sandy loam
Fa....Fluvents, stony
HaE..Haire loam
LeD..Lockwood shaley loam
Ps....Psamments and fluvents
Rc....Rock outcrop-Xerothents association
ScE..San Andreas fine sandy loam
Sg....Santa Lucia-Relez association
ShC..Santa Ynez fine sandy loam
N
Sg
ScE
AsC
LeD
Fa
Ps
ShC
AsC
Rc
HaE
Fa
Ps
M I L P I T A S
W A G O N C A N Y O N
R E S E R V A T I O N
The Indians
BM 1857
TELEPHONE
Pinal
Merle Ranch
Avila Ranch
3997
290 00
FEET
3996
3995
5'
3994